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(54) Apparatus for Continuous Production of Tubular Wrapping of Flexible Sheeting.

The apparatus is used for transforming a flat sheeting (4) into a cylindrical wrapping and, for this purpose, comprises a curved deflector surface (20) which is formed by the intersection of an imaginary cone and the thick wall of a cylindrical pipe (1). The vertex (S) of the cone lies on the axis (a) of the cylindrical pipe (1) and the axis (b) of the cone is directed obliquely in relation to the axis (a) of this cylindrical pipe (1).

Description

The invention relates to an apparatus for continuous production of tubular wrapping of flexible sheeting according to the specification of patent claim 1.

Such an apparatus is used, for example, in installations for packaging products which are extrudable when hot, such as cheese, in bags or sacks and is, for example, disclosed in the US-PS 35 42 570. In this known installation, the apparatus comprises three deflector surfaces for forming the tubular wrapping consisting of round metal sheets. It is also known to use deflector sheets which have a shape similar to that of a sailor collar. All of these deflector surfaces have the common feature that they comprise a large contact plane with the sheeting to be made into wrapping and that they transform a flat surface, while changing the direction, into an almost cylindrical surface.

To package cheese in single slices, it is known to use a sheeting with the tradename Mylar (trademark of DUPONT DE NEMOURS). With such a material, the known deflector surfaces do not give any problem, Mylar, however, is an expensive material, and furthermore, it is neither heat-sealable nor hot-weldable.

Therefore, it is desirable to use a cheap and hot-weldable material such as polypropylene. However, sheeting made of polypropylene, has the tendency to stick to a metal surface when cold because of the electrostatic effect. This disadvantage could be eliminated by grounding the metal surface with the help of which the wrapping is formed. However, the disadvantage that the sheeting tends to form folds when tensile strength is applied remains, because the surface of the metal sheets used for making the wrapping until now is geometrically not correct. To package extruded cheese it is necessary to work at a temperature of approximately 80°. Under these conditions, there is the danger that the softening polypropylene sheeting which generally has a thickness of approximately 20 μm remains sticking to the surface

producing the wrapping and tears apart.

The object of the present invention is to form an apparatus of the type disclosed in the specification of patent claim 1 which avoids the above-mentioned disadvantages and allows to use thin sheeting of polypropylene or similar material as packaging material at the higher, described temperatures.

This object of the invention is obtained by the features given in the specification of patent claim 1.

Preferably, the axis of the cone forms an angle with the axis of the cylindrical pipe in such a manner that the unwinded intersection curve of the cone forms a parabola with the cylindrical inner surface of the pipe, whereby the plane lying tangentially to the cone and which contains that surface line of the cone which has the maximum distance from the axis of the cylindrical pipe defines that plane in which the sheeting is fed to the apparatus, that is, in which it reaches the deflector surface. In this case, the surface forming the wrapping is geometrically exact in such a manner that the sheeting does not experience any transverse strains and, therefore, does not form any folds.

In all cases, this surface is narrow in such a manner that the slowing down of the sheeting by adhesion practically plays no roll.

The apparatus according to the invention does not only allow the use of polypropylene sheeting with a thickness of 20 μm in the hot state, but also of very thin sheeting with a thickness of, for example, only 10 μm.

According to a specific embodiment, the cone comprises a vertex angle β of 60° and for the angle α between the axes of the cone and the cylindrical pipe the equation $\alpha + \beta/2 = \arcsin 2/\pi$ is applicable.

Choosing a cone of 60° allows easy calculation of the angle α and, furthermore, treatment of the deflector surface with simple

and conventional means.

An embodiment of the invention is illustrated in more detail by means of drawings. It is shown in

Fig. 1 a schematic view of the main parts of a packaging machine with the apparatus for producing a wrapping.

Fig. 2 a side view of this apparatus.

Fig. 3 a section along the line III-III according to Fig. 2.

Fig. 4 a view in direction of arrow A according to Fig. 2 and

Fig. 5 representations for illustrating the thought which led to the deflector surface according to the invention.

The machine represented schematically in Fig. 1, comprises an apparatus for producing a wrapping with a vertical, generally cylindrical pipe 1, into which inserts a feeding pipe 2 from its upper end which is fed with the product to be packaged from a storage funnel 3. The packaging material consists of a sheeting 4, for example, of polypropylene, which is unwinded from a spool 5. This sheeting runs over a deflector spool 6 and then over the upper edge of pipe 1 into which it is pulled down, whereby the wrapping 7 is formed. Thus, both edges of sheeting 4 overlap and are welded in pipe 1 with the help of a heating element, that is right before wrapping 7 is filled with the product to be packaged, which is, for example, cheese melted at 80°C. That is, the welding of wrapping 7 occurs above the lower end of feeding pipe 2. In the case that the product to be packaged is cheese which is to be packaged in cut portions, that is, in form of slices, the lower end of the feeding pipe is flat and the produced wrapping 7 of polypropylene adjusts to the form of the end of this feeding pipe 2, as is represented at 8.

The wrapping 7 containing the product to be packaged then reaches an installation 9 for forming portions. This installation 9 consists of two endless belts 10 and 11 which are equipped with press elements 12 and 13, which are pressed against one another when both belts 10 and 11 rotate uniformly to pinch the wrapping 7 and to separate the product in this manner in portions 14 as is,

for example, disclosed in US patent 35 42 570.

The wrapping machine represented in detail in Fig. 2 to 4 consists of the described pipe 1 which comprises a thick wall and which, in the illustrated example, is preferably composed of two half pipes 15 and 16. The half pipe 15 is secured to a support 17, while the other half pipe 16 is movable and is attached to a flange 18 coupled to 19, so that the pipe 1 can be opened and closed. This formation makes the operation of the apparatus and the maintenance of the wrapping machine easier. Furthermore, the flexible half pipe 16 carries underneath the flange 18 the described heating element for the hot-welding of the wrapping 7.

The upper edge of pipe 1 has a deflector surface 20, which is formed by the intersection of an imaginary cone with this pipe. This cone has an apex S which lies on the axis a of the cylindrical pipe 1 and a vertex angle β of 60° shown in Fig. 5; the axis b of the cone forms an angle α with the axis a of the cylindrical pipe 1, whereby the equation $\alpha + \beta/2 = \arcsin 2/\pi = 39.5402°$, which will be explained later, is applicable.

The sheeting 4 reaches that tangential plane of the cone which contains the surface line g of the cone, which lies in the same plane as the axes a and b and which has the maximum distance from the axis a of the cylindrical pipe 1. The experience confirms that the sheeting 4, while moving over the deflector surface 20, continuously changes from a flat shape into a cylindrical shape, whereby it changes the direction on the edge 21, which is formed by the intersection of the cone with the cylindrical inner surface of pipe 1; there is neither a bonding nor fold formation of the sheeting which begins to wrap the conical plane 20 in a natural manner before it is pulled over the edge 21 with a minimum of transverse strain.

The cone can have a vertex angle which is different from 60°, whereby then the angle α has a different value as well, which can

be determined by an experiment or calculated. In particular, it can be determined with the calculator.

The use of a conical deflector surface is not the result of a casual choice, but it is based on an inventive thought which is simultaneously empirical, experimental, and mathematical. This is illustrated by means of Fig. 5. The end of sheeting 4 is shown while being inserted into pipe 1. During the period of this insertion, the sheeting 4 suddenly changes its direction. When the corners A and B of the end of the flat sheeting 4 are taken and these corners are symmetrically bent in the direction of the middle line, then two folds 22 and 23 are formed, of which each one forms an angle δ of 45° with the edge of the sheeting.

On the other hand, a flat sheet can be wrapped very easily on a cone. Moreover, a cone with a vertex angle of 60°, when unwinded, has the characteristic feature that it forms a half circle 24, the diameter of which is equivalent to the width L of sheeting 4. When the cone is formed out of this half circle, then the ends C and E of the diameter 24 of this half circle are combined. When sheeting 4 is wrapped, the same points C and E which lie on the edges thereof coincide as well.

When in an experiment sheeting 4 is wrapped on a cone and then runs in a cylindrical form while changing the direction and, when the curve points of the obtained reversed edge are taken and calculated, then an unwinded curve is obtained in the plane which is very similar to a parabola.

In the following, it is presumed that this unwinded curve is actually a parabola. In Fig. 5 it is seen that the angle $\delta = 45°$ is equivalent to the angle of the tangent at the points C and E of a specific parabola the focal point of which is point S and the focal ray f of which is equivalent to L/4.

When the cone is again formed and this cone is put on pipe 1, then the vertex P of this parabola falls on the upper edge of pipe 1, that is on the surface line lying in the plane of sheeting 4,

as is shown in the bottom part of Fig. 5. The points C and E also coincide at the edge of pipe 1 on a surface line of the cone which is coplanar with the axis b of the cone and the axis a of the pipe 1. The axis b of the cone is oblique in relation to the axis a of pipe 1. When the vertex angle of the cone is designated as β and the angle enclosed by the axes a and b with α, then it is seen in Fig. 5 that

$$\sin(\alpha + /2) = D/2f,$$

whereby D is the diameter of pipe 1.

By substituting f with L/4

$$\sin(\alpha + \beta/2) = 2/\pi$$

is obtained and, therefore,

$$\alpha + \beta/2 = \arcsin 2/\pi = 39.5402°$$

For treating pipe 1, it is enough to know the angle

$$\gamma = 90° - (\alpha + \beta/2).$$

The experiments conducted with a piece treated in this manner showed that the sheeting is completely wrapped.

It is understood that the same result can also be obtained with a cone the vertex angle of which is different from 60°, however, in this case the angle α must also have a different value.

Half pipe 16 is laterally cut in its upper section by a plane

which lies parallel to the axis of pipe 1 and tangential to the inner surface of this pipe. Furthermore, in the section cut in this manner, the half pipe 16 comprises a wide vertical opening 25 (Fig. 3) which is covered by two in this opening partially overlapping sheets 26 and 27, whereby the end of sheet 26 is curved in such a manner that it is adjusted to the curve of the cylindrical inner surface of pipe 1. These sheets 26 and 27 are used for making both edges of sheeting 4 to overlap which are welded further down by the heating element at the bottom part of pipe 1.

It is understood that these two welding edges of sheeting 4 are not included in the views in Fig. 5.

What is claimed is:

1. An apparatus for continuous production of tubular wrapping of flexible sheeting (4) with a curved deflector surface (20) followed by a cylindrical surface over which the tubular wrapping (7) is pulled, characterized in that the curved deflector surface (20) is formed by the intersection of a cone with the thick wall of a cylindrical pipe (1), the inner surface of which represents the described cylindrical surface, in that the vertex (S) of the cone lies on the axis (a) of the cylindrical pipe (1) and in that the axis (b) of the cone is oriented obliquely to the axis of the cylindrical pipe.

2. An apparatus according to claim 1, characterized in that the axis (b) of the cone forms an angle (α) with the axis (a) of the cylindrical pipe (1) in such a manner that the unwinded curve of the intersection between the cone and the inner surface of the cylindrical pipe (1) is a parabola and in that the tangential plane of the cone which contains the surface line (g) of the cone which is coplanar to the axes of the cone and the cylindrical pipe

and which has the maximum distance from the axis of this cylindrical pipe, defines that plane in which the sheeting (4) of the apparatus is fed.

3. An apparatus according to claim 2, characterized in that the cone comprises a vertex angle (β) of 60° and in that for the angle (α) between the axes of the cone and the cylindrical pipe (1) the equation $\alpha + \beta/2 = \arc \sin 2/\pi$ is applicable.

4. An apparatus according to one of the claims 1 to 3, characterized in that the cylindrical pipe (1) consists of two parts (15, 16) which are flexibly coupled to one another by an axis lying parallel to the axis of the cylindrical pipe.

5. An apparatus according to claim 4, characterized in that the cylindrical pipe (1) is laterally cut off in its upper section which is surrounded by the deflector surface (20) by a plane, which lies tangential to the inner surface of the cylindrical pipe and which contains the surface line, which lies diametrically opposite to the surface line through the highest point of the cylindrical pipe which lies in vertical position and in that the cylindrical inner surface of the pipe comprises a vertical opening (25) in this tangential plane.

6. An apparatus according to claim 5, characterized in that two deflector sheets (26, 27) are planned at the cylindrical pipe (1), which overlap before the described opening (25).